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Research Support Study: Agriculture; University of Connecticut Local Report

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**Research Support Study: Agriculture
University of Connecticut Local Report**

University of Connecticut
Study Team: Carolyn Mills and Sharon Giovenale
Babbidge Library
November 11, 2016

Report Structure:

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INTRODUCTION

What resources and services do agriculture faculty members need to be successful in their research? The University of Connecticut (UConn) Agriculture Research Support Study Report examined the research practices of academics in the College of Agriculture, Health and Natural Resources (CAHNR) in order to answer this question. This local study is connected to a suite of parallel studies conducted at eighteen other US-based higher education institutions with agriculture departments, under the auspices of Ithaka S+R, a not-for-profit research and consulting service that helps academic, cultural and publishing communities. Ithaka S+R was hired by the participating institutional libraries to provide guidance on research methodologies and data analyses. Previous similar subject-based studies conducted under the auspices of Ithaka S+R include Supporting the Changing Research Practices of Chemists, Research Support Services for History Scholars and Supporting the Changing Research Practices of Art Historians. The goal of Ithaka S+R research support service studies is to bring a scholar-centered approach to gathering information about evolving research support needs. The audiences for this report

are the library, the CAHNR administration, and the broad University of Connecticut community which supports academic agriculture faculty in their research.

Agricultural research at the University of Connecticut is primarily conducted in the College of Agriculture, Health and Natural Resources (CAHNR.) The College's academic plan cites two major areas of strength and opportunity: Food, Nutrition, & Health and Environmental & Agricultural Sustainability (College of Agriculture, n.d.).

Agricultural researchers participating in this study came from two CAHNR departments, the Department of Animal Science and the Department of Plant Science and Landscape Architecture. Research in agriculture at the University of Connecticut is increasingly interdisciplinary and ranges from basic science to intensive field work. Research areas included in the Department of Animal Science are animal nutrition and metabolism, control of lactation and growth, embryology, endocrinology, food microbiology and safety, food science, molecular growth, and muscle physiology, reproductive physiology and stem cell biology. Research areas included in the Department of Plant Science and Landscape Architecture are controlled environment agriculture, floriculture, improving ornamental crops, integrated pest management (IPM), landscape architecture, plant biotechnology, plant mineral nutrition and container media, plant physiology and plant growth regulation, plant propagation, soil chemistry, soil environment and land use, sustainable agriculture, turf, vegetable crops, water resources, and weed biology and control.

For the purposes of the study, agriculture was defined as research into the science and practice of farming, both crops and animals. Selected study subjects were conducting active, grant-funded research in some aspect of agriculture. The study methodology is described in more detail in the next section.

Researchers provided descriptions and insights about their research and how it relates to the broad field of agricultural scholarship. They spoke about their research methods and any related challenges, how they find information, disseminate their results, and archive their data. They also reflected on the future of agriculture research.

This report contains the following sections: introduction, methodology, findings, conclusions, references, and two appendices. The findings section contains the bulk of the report, written as a narrative with faculty quotations to illustrate the significant patterns identified in this study.

The local study team for this project was Carolyn Mills, the Biology, Agriculture and Natural Resources Librarian, and Sharon Giovenale, the Pharmacy Librarian, both employed by the University of Connecticut Library.

METHODOLOGY

In December of 2015, the University of Connecticut Vice Provost for University Libraries agreed to participate in a qualitative analysis of research practices in agriculture coordinated by Ithaka S+R. The two librarians identified to participate in the study successfully completed the UConn Collaborative Institutional Training Initiative Human Subject Research Course and submitted an Institutional Review Board proposal in late January 2016, which was approved in March. The study team attended an Ithaka S+R webinar covering sampling and recruitment practices and a two day training session in ethnographic methods provided by Ithaka S+R at the University of Florida in April, 2016. The study was conducted simultaneously by teams at a total of nineteen U.S. institutions with significant agriculture programs. The national study was sponsored by the United States Agricultural Information Network and the local study was funded by the University of Connecticut Library.

The interview protocol was developed by Ithaka S+R for consistency. Volunteers were recruited via email invitations sent to UConn researchers who met the study's definition of agricultural research. The recruitment email is in Appendix A. The CAHNR Associate Dean for Academic Programs and Research endorsed the research project to CAHNR faculty and asked CAHNR department heads to encourage faculty participation in the study. No compensation was offered to the participants.

Twenty nine researchers in CAHNR were invited to participate in this study. Nine researchers - five members from the Department of Plant Science and four members from the Department of Animal Science - participated in semi-structured interviews. The researchers held the following ranks:

Rank	Interviewed
Full Professor	3
Associate Professor	2
Assistant Professor	3
Extension Educator	1

In each interview a member of the study team asked a set of predetermined questions in the researcher's office. The questions were provided by the Ithaka S+R service for consistency across the participating institutions, although the study teams were encouraged to ask clarifying and follow-up questions. The questions included the focus of research, individual research and dissemination practices, the current state of the field of agriculture and speculations on its future. The eleven study questions are in Appendix B.

Interviews were digitally recorded, transcribed and then coded separately by the study team members. All material was anonymized and kept in secure locations. After individual coding the study team group looked for core themes. From these themes and from the narratives of the researchers, the findings were discerned and the final report was written.

FINDINGS

Finding 1: Money

Money is at the root of all research, and there is never enough. All of the interviewed faculty expressed money woes, both internally and externally. Funds are needed for graduate student assistance as well as for specific research tools, supplies and resources. The biggest challenge for most of the faculty is getting funding - internal, external, or both. Once funding is available everything else becomes possible – research assistance, attention to other details, and the resources and equipment needed to work on and complete research goals. Not all funding from every source is created equal. The way in which funding is made available and the participation of the institution in the funding process also matters. Additionally, stretching existing grant dollars to cover everything that needs to be covered is a problem. *“I think that the broadest biggest challenge is funding for research. It gets more and more expensive but the grants don’t necessarily get bigger and the total pool doesn’t get much bigger ... people are hiring more faculty that are going to be required to do research and be externally funded ... graduate students get more and more expensive, supplies get much more expensive,”* said a researcher. In an effort to secure adequate funding, faculty seek collaborations, change the direction of their research and use whatever help they can find. Although other funders are represented, the USDA is the major funder for most of the agriculture researchers interviewed. *“The funding from USDA pretty much drives agriculture in the United States,”* said one researcher.

A. Availability of funding

Funding from federal sources is limited and the process of acquiring it is grueling. Availability of federal funding determines the direction of research activity and to some degree the quality of the research. According to researchers interviewed, it has gotten more difficult to find funding and there is more competition for the funds available. *“These days it’s gotten harder and harder and you have to convince people that your project, as opposed to these nine out of ten other projects that are worthy of funding, why this one should be funded when they’re all worth funding.”*

Funding availability drives the direction of research, and researchers can be left hanging when funding imperatives change direction. *“Sometimes I have good ideas which we believe in and we want to do [the] project but we cannot find funding.”* So what actually ends up being researched may be different from what faculty were originally hired to do and often what they really want to do as well. *“It might not be your area but there’s so much pressure on us young faculty to get grants and to publish, you just have to do that.”* This is especially a problem for junior faculty who do not yet have a track record to help convince a funder that they’ll get the job done. *“The funding rate is so low, it’s really hard to get funding and especially as a junior investigator who is just establishing myself in the field.”* In essence, many researchers find that their research follows the direction of funder priorities.

While the majority of research funding comes from external sources, internal support for research is also seen as critical by faculty. The biggest need for internal funding is for student assistantships and, to a lesser degree, for equipment. Faculty are constantly balancing the funds available both internally and externally with what is required to do their research. *"Internal opportunities become much smaller, so that you almost have to find the external dollars but the external dollars are becoming more difficult to get. And even when you get them they're often times not enough to really do the experiment that you would really like to do. So sometimes you're cutting out variables, sometimes you're cutting out measurements, but there's always that compromise in what you get done for the amount of funding that you have."* Availability of internal support is crucial for research both at the beginning of a researcher's career and periodically throughout that career. Internal funding provides the seeds for external funding: *"I really can't do the experiment until I get funded but I have to do half the experiment before I get funded so I have preliminary data. And it used to be that getting money to do that preliminary stuff was available, in-house or in some ways. That's drying up as well."* A successful research program requires institutional support as well as external support throughout the research lifecycle, covering the gaps when external funding is not available to support students, equipment needs, and the seeding of future research projects.

An additional related point which a researcher made is that a steady stream of funding is the optimum situation for a research project, rather than funding which stops and starts. External funding is mostly a stop and start mode, available for a limited amount of time, but the actual needs of research projects are constant. When asked about what would help his research this researcher said, *"A steady stream of budget ... Don't give me a million dollars this week and then never give me any again and expect me to get it all spent in 3 years."*

One researcher noted the difference in the way the institution's sponsored programs service treats private funder proposals which allow little or no indirect costs as compared to federal funders which allow high indirect costs. He said that the private foundations he deals with will have an indirect return rate from 0% to 10%, as compared to federal funder rates which can be anywhere from 33% to more than 50% in indirect costs allowed. *"Whether it's obvious or not, there's a lot more weight given to your research when the indirects are high, because the return to the university and to the college and to the department is higher. Whereas I'm just trying to do my research, that doesn't affect me directly, well it does but not immediately. So if I find a foundation that's willing to fund my research and its 0%, they don't pay indirects, then the university, I feel, does not like that. Because there's no kickback support to them. Which makes sense so why would they go through all the work of processing my grant application, doing all that and then they have to pay that staff that does that but I get all the money. But even 10% is still not looked upon very highly."* In this researcher's experience the foundations he works with want the funding to go primarily or completely to the research itself rather than to the institution so they limit what they provide, and even the USDA will sometimes limit what goes to indirect costs. *"And a foundation's going to go 'We're not giving you \$200K to get \$100 K of research back.' So that's a big thing that I've struggled with. Sometimes when you put in an*

application [to sponsored programs], the rush to get to that one versus one that has a higher indirect can be different. And I've been told that some won't even take low indirect projects. Like don't even put them in because it's of no value to this university to get that. All rumors, I don't know if it's true. But that becomes a big challenge."

B. Minions

Faculty need assistance to complete their research. With the unrelenting demands on faculty time it is impossible for them to handle all the necessary aspects of a research project. The most common and affordable type of assistance for a research project is to have one or more dedicated graduate students, either masters or Ph.D. candidates or both. If a lab is particularly well funded or if a grant funding plan works out just right, a postdoctoral position might be available, but that is rare. With departmental or school funding, hiring a technician to assist is possible, though even rarer. Funding for any assistant position will either come internally from the school or externally from a grant, or sometimes from a combination of the two. According to interviewed faculty, CAHNR has reduced departmental funding for graduate research assistance in recent years so that there are a limited number of internally funded research assistantships available. *"There's only so many assistantships available and if you're in a really successful department with a lot of active PI's there's not a lot of students to go around."*

For researchers in active departments internal assistantships get snapped up very quickly, and then the only way to pay for a student is through grant funding. However putting a graduate student on a grant proposal is problematic for two reasons. First, funding a student eats up a significant portion of the funding which could otherwise go towards research: *"Between the overhead for the university and a student it's more than half the grant. I can't do it without a student. I need more than one but I can't afford more than one and actually get any research done."* And second, including the cost of a student in the proposal potentially makes the grant less competitive to the funder. *"You're asking for support for a student from the funder, so if I was up against a place that funds that student, the cost of doing research isn't that high, my research is not that high but when you throw a student into it, it becomes extremely expensive. I've lost grants because they'll say 'You asked for \$120K for this fairly simply project.' But I need a student to do it. 'Oh, well we gave that project to so and so because they didn't ask for the student, they just asked for the supply money.'"*

Graduate students are the least expensive solution to finding research assistance but they are also the least productive for actually getting research done. *"...to train a student is not easy and so when a faculty first opens his lab and he needs time, he will recruit a new student. He wants to train the student and until the student basically is proficient to a certain degree in the cell culture and the molecular biology, it takes a year. This means that in the first several years the faculty can do very limited stuff, research, because once he becomes a faculty he has very little time to do research by himself."*

More expensive and harder to come by are postdoctoral and technician positions. These positions are valuable because they are devoted to getting research done and are either already experienced (postdoctoral) or are available over an extended time period (technician.) *“Postdocs don’t take classes and they are already proficient in certain techniques and they have certain training in terms of the critical things in research.”* Some faculty see the postdoc or technician option as the most preferable: *“I wish I could afford a post doc or a tech. Nobody, I don’t think anybody in our department has a technician. And technicians and post docs get more research done than graduate students and undergrads. So the productivity of a lab that has a post doc or a technician is huge. I just can’t afford that, you know? I can’t afford that in a USDA grant, I can’t afford that without a grant because I have no money without a grant.”* Non-matriculating technicians also have the added benefit of not becoming future competitors for precious grant dollars. Speaking of graduate student assistants one researcher stated, *“They’ll do my work, they’ll learn something, they’ll graduate and now I have 5 people I’m competing with grants for or 5 students that have no place to get a job.”*

This existing manpower/funding problem is exacerbated by the recent unionization of graduate students at the University of Connecticut. *“When you put that into a grant to get a student it eats away the funding very quickly so it’s hard to get people to do the work because they’re so expensive. And those numbers go up, they never go down really. And now we have a union and I’m all for a graduate student union but that’s creating all sorts of issues too, so those make research difficult. So what could help with my research really comes down to all these funding issues and support for students, support for the research.”*

The bottom line is that without students, postdocs or technicians the research won’t happen, and relying on researchers to include funding for that assistance in their grant proposals makes those proposals less competitive compared to those from peer institutions which provide more internal funding for research assistants.

C. Equipment

Access to equipment and instruments is crucial for many research projects in agriculture. Much of the necessary equipment is available from the college itself or through centralized university programs. Some researchers have purchased their own equipment in the past but current equipment needs are hard to fund. Few grants come with an equipment budget, as one piece of specialized equipment can cost \$50,000 to \$100,000. Several of the researchers spoke of using university centralized equipment at the Center for Open Research Resources & Equipment (CORE) or the Center for Genome Innovation. Some research equipment is owned and housed locally at CAHNR as well. In response to technology changes, researchers spoke of investigating collaborative purchasing within a department or within CAHNR, with college assistance. University-based matching equipment grants also require local college funding. Access to high quality equipment can make or break a career, and equipment failure, from old age or from being moved to a new location without a repair contract, can effectively end a career. As one researcher said, *“Your equipment begins to die and you die with it and out you*

go.” Most of the researchers interviewed were reasonably content currently with access to equipment but as technology changes and increases the need for access, newer and better equipment will be an ongoing agriculture research funding need.

Finding 2: Information seeking and dissemination

Information seeking is part of every research project, bridging the gap between the specifics of the project and the broader scientific world in which it exists. Interviewed faculty talked about two main types of information sources, literature and professional networking. The main literature consulted in information seeking is the primary peer reviewed research article. The main vehicle for disseminating research results is without exception through primary articles in peer reviewed journals.

A. Literature

Agriculture researchers have a clear appreciation for the traditional role of the library in providing access to journal articles and other literature. When asked about the most important thing that the library could do for him, one researcher said, *“I think it’s making sure that the library stays open, make sure we have those resources ... It’s the resources that we need have to be available.”*

The types of literature which faculty consult vary depending on their areas of research and include literature as diverse as information on cultivars, company R&D, and accounts of the latest molecular techniques. While the peer reviewed journal literature is most commonly consulted, researchers also regularly use conference proceedings, organizational reports, books, and historical records.

To discover relevant articles the interviewed researchers tended to use either Google Scholar or PubMed or both. Less frequently they use CAB Direct and Scopus, and even less frequently Agricola. Many faculty use Google Scholar predominately. Several use Google as well as Google Scholar to start broad searches, narrowing down to Google Scholar as they narrow their focus. . *“Well the search engine in the computer is where I start, just type in a question on Google and see what comes up ... Google mostly ... more than Google Scholar. Usually when I narrow down the field I’ll switch to Google Scholar. But to initiate a broad search I’ll go to Google.”*

A few researchers use databases predominantly. *“I’ll use either CAB Direct or PubMed for almost everything. Because in these analyses, although we relate them to animal models, the PubMed still has the best, the most complete. Sometimes I’ll use Agricola because they’ll have review articles that might be really related to animals, but I would say almost all of it is CAB Direct and PubMed.”*

Review articles are also an important source for some. *"If we are particularly interested in certain *****¹ we may review tons of reviews – Nature, Science, Cell, they all publish annual reviews to certain *****. So that's where we want to collect the most up to date information and then if we are particularly interested in a special ***** then we can dig out further and for additional reviews or the original articles and find out more."*

For the most part the faculty do keyword searches for active searching, and they use either database- or journal-based alerting services using keywords or tables of contents for passive searching. Alerts are considered very important by those that use them. *"I have PubMed search results emailed to me on a weekly basis, so for the things that we have to stay up to date on ... in those really important areas I get those updates weekly."*

For some, literature use is cyclical. Some important alerts are received regularly, but the bulk of searching can happen more infrequently. *"The other areas tend to be more when we're grant writing or we're writing a paper or when I've got a student that's interested in an area and needs some background or something. Then we'll do a lot of searching. But a lot of it is when we're writing, either for publication to make sure we're up to date on what's come out since we've started looking, or when we're putting together proposals for the next set."*

There is never enough time for reading the scholarly literature, even though it is so important. One researcher said, *"I could improve my science by devoting more time to perusing the literature."* Another researcher stated, *"The work I'm proud most for research is the work I did for my PhD. Because that was when I had a lot of time to think. The problem is I work always."*

Some faculty deal with the need to keep current by giving their graduate students information-finding assignments. Then the students learn and the faculty stay up to date. *"I sometimes assign students a paper, ask them to read and make a presentation, so I and others attend their discussion in the very special area we are particularly interested in, which is the direction of our research."*

B. Networking

Faculty get a lot of their information through attending conferences, both through listening to the formal conference presentations and also by networking with colleagues. *"It's all by social contact ... and then in the background, for example I may have cards and cards, you go to the meetings and we're always switching cards. On the back I may write memos as to what it was we were talking about. I review them later to try to remind me but these cards are very useful actually, at least to remind you who to look up because you may not remember the names. So going to as many meetings as you can, I try to go at least once a year."* Connections through societies are crucial for information gathering and making connections. *"We were still*

¹ The asterisks are used to anonymize the individual quoted.

communicating with others but our research progress is through scientific presentations in the meetings. Most of them are invited presentations."

The societies to which researchers belong change as their research changes. Those faculty who work in cross disciplinary fields may have no specific society to address their information needs, so they spread themselves across a collection of societies which each touch tangentially upon their topics. Other faculty change their research focus over time and so need to change their society associations. Deciding which society and meeting to spend time and resources on is important. *"It's a real issue for science research - what meeting ... do you want to devote your time to? When I was a graduate student, my lab supervisor had been editor in chief of the ***** journal for 40 years. I grew up belonging to that society and going to the meetings every year without question. I have for most of my career. And I'm deciding now whether or not it's worth it because I need to go to specialty fields, special conferences."*

Most of the faculty interviewed attend at least one professional meeting a year, more if they can manage it. The limiters are money and time. This is a problem especially for those who work on cross-disciplinary topics without an existing professional society, as they have a number of potential meetings for which attendance could be valuable but none of which cover their topic fully. But even researchers with clear society associations have multiple meetings of interest. They tend to alternate attendance at different meetings, attending each every second or third year to stretch their time and money as far as possible. *"I try to attend where there are big conferences with this group. So now I'm trying to go once or twice a year to attend all of them once in a few years. Each of them once in 2-3 years. I just don't have time to do it more frequently."*

Less formal meetings also play a role in information gathering. Some faculty belong to multi-state Hatch projects where they exchange unpublished data with others working in similar areas. *"We're all ***** biologists so that's a great group, again, for that, 'This isn't published yet, here's where we're going with it,' and kind of getting a feel for the state of the field in a smaller sense."* For others phone meetings or smaller group meetings play a large role in staying up to date. *"We do conference calls every Tuesday morning when it comes to ***** so we can keep up with what's going on in the field that way."* One-on-one information sharing is also fairly common. *"Email, direct conversations, sometimes I just pick up the phone and call them. If we know each other sort of or if we don't I'll just introduce myself on the spot and take it from there ... if you call them on a topic of their specialty they're usually glad to talk and share an opinion."* For some researchers contacts in industry are very useful. *"I usually check in at a meeting, I'll see so and so, and say 'Hey you guys have anything you're working on?' Trade shows I'll go through and see what kind of products are out there that aren't currently being used for ***** and I'll say 'Oh, do you think this will work, any interest in working with me?' So I kind of keep up with some of the products that are out there for other industries because there's a lot more going on out there."*

C. Dissemination

Publishing primary research in peer reviewed journals is central to all of the interviewed agriculture researchers. Some of them produce other types of publications as well, but without exception the research article is their primary means of disseminating results to other researchers, with meeting presentations as their secondary means. How they select a journal to publish in varies. Journal specialty is always important, but for some the audience they will reach is far more important than the impact factor of the journal. *"I think a lot of people shoot for the highest impact journal they can get published in. I don't do that because I've seen people, colleagues, publish in high impact journals I've never heard of before and all of the articles I've ever even just glanced over, I've never seen some of these before. To me I don't see the value in publishing in that journal ... [where he does publish] the journal as a whole might not get a lot of citations so its impact might be low, but the impact of my paper personally I feel is as high as it would have been if I put it anywhere."*

Finding this target audience takes different strategies. For some it is about the prestige of a journal within a particular discipline: *"We aim for kind of the higher tier animal science journals, so Journal of ***** is one that we try to get in and that's been fairly achievable for our research. With this current study we'll probably aim for some of the ***** journals ... So we'll try to aim a bit bigger with that one to get a broader audience with that one. But it's generally kind of specific to what the publication is ... we really look at who the audience should be for the research and then try to target the higher journals, if the research merits it, right? Sometimes the research is meh novel and meh exciting and so we go to meh journal, one that's ok."*

Sometimes the determining factor is the type of model animal used. *"Some of the more biology-oriented journals don't like that we use large animals as a model."* But determining the right journal in which to publish can be a very specific fit, requiring knowledge of the focus of the journal and the audience reading that journal, which is acquired with experience. *"So it's really specific to the project. For my main focus, my main research, I usually try to figure out where most similar papers are published, so if my work cited is all in one journal, it's pretty much a no brainer that that journal is going to be most receptive to it and that audience will be most receptive to it ... because all my reference material is coming from that journal and I know the society well, I know the readers, this is the place that they'll want to read this type of paper."*

Faculty also publish other types of literature, mostly book reviews, conference papers, and book chapters. *"Anything that happens in the ***** arena makes its way to me. There's just not a lot of people working on it. If a review needs to be done or a book chapter needs to be written that has anything to do with ***** it usually comes across my plate."* But no other publication is as respected as the primary research article. *"Ninety percent of what I respect, when I look at packets if I'm evaluating someone or someone's evaluating me, is the peer review standard research journal."*

Finding 3. Technology

Technology is changing constantly on many fronts and the pace of change strongly impacts researchers' work and how they stay current in their fields. A consistent theme during interviews was that researchers feel the impact as they learn about and incorporate new techniques and discoveries. This need to keep up influences how they find information, how they make contacts, and how they distribute their own discoveries.

To illustrate the pace of change: *"A good example although it's not my field, is we have flow cytometry and when flow cytometry first was around – 20 years ago or so – I went "oh, counting cells, who cares?" and flow cytometry has been able to impact a billion fields and you could do so many different things ... I imagine that technologies will allow me to really generate far more understanding in the next 5 years than we have in the last several decades about whatever."* Said another researcher: *"There's the opportunities from the technology that's emerging and it's been the case since I got into this, I mean technology's always getting better. If we had this interview 15 years ago I would have said the same thing. But that's really where the opportunity's going, it's going to be technology."*

This pace of change affects the ability to do research, from learning about the technology to incorporating it into existing methodology with a limited budget. Discovery of new tools can be problematic. *"My colleagues are using it but I haven't even caught up yet. I plan on using it but it's happening so fast that many of us, it would make a lot of sense to use ***** technology to do some of the things that we're doing. I plan on doing that."*

When asked what would be most useful to his research, one faculty said, *"Really knowing whether or not someone somewhere has done something relevant that I'm not aware of. When it comes to the kind of research I do, I would say that it isn't something that I could be just doing. There are people that are knowledgeable about methods and approaches that ... if I was aware of them it would help me. It would improve my own work."*

Professional societies do play a role in helping researchers keep up with new tools and ideas. Some societies have newsletters about developments and some schedule sessions at national meetings on recent technology and learning about new tools. *"At the meeting I went to last week, as I was listening to talks I emailed myself things like a new ***** modeling program that they used for their studies. I'll put that email in a folder for when I want to look at the 3 dimensional studies of ***** that I'm studying. I'm getting old, it's hard to keep up."*

Researchers often find out about new tools from colleagues, but the scholarly literature is another avenue of discovery, as authors describe the tools they are using. *"Because someone's going to make a breakthrough and they're going to cite, they're going to use something."*

What researchers then do with that information and how they put it into practice, is another challenge since no one can use everything immediately. *"There's more and more tools that you*

can use in biological research, in all scales and all fields ... There's a lot of new tools to generate large data so that's daunting. So I only stick to what it is that I need immediately, what I ask the people I work with and myself to try to figure out how to get the resources for, but there's a lot of resources. I would say that in science these days having an ability to manage the tools that are available is pretty important."

Finding 4. Potential avenues of support

All of the researchers are stressed and pressed for time. They are dedicated to their research but struggle to accomplish enough, given the many other obligations under which they operate. Out of the interviews came some ideas for how to support researchers.

A. Writing assistance for non-native speakers

For those researchers who are not native English speakers, formal writing is a difficult, time consuming, and stressful task. One faculty member said that three quarters of the time he spent writing manuscripts was on the language side and only one quarter of his time was spent on the science itself. His idea was to provide a consistent, reliable staff assistant at the college or departmental level with strong writing and editing skills to work with non-native researchers on their manuscripts and proposals. *"They can drastically improve the productivity of our faculty members and graduate students if we have one person just ... doing that ... I think it is going to have some very significant impact."*

B. Balance between research and regulations

At the University of Connecticut the Institutional Animal Care and Use Committee (IACUC) regulates conditions of animal care and procedures. This was an issue for one researcher who worked with livestock research subjects. *"I think the mission of IACUC is important and right, they are there to protect the animals and make sure, you know, bad stuff doesn't happen."* However large animals like livestock are different from the type of small research animals such as rodents that the IACUC generally regulates and the differences must be accounted for. *"You can keep rodents in a clean room. We don't have facilities for clean rooms for livestock. That's not even feasible in our current situation."* There are significant administrative challenges to overcoming these oversights, so adapting the IACUC regulations for realistic use with livestock research subjects could be a useful goal.

C. Technology tool heads-up and training

Keeping up with the latest technological tools is an ongoing challenge for many researchers. They stay informed about new possibilities through meetings, from research articles, or via colleagues. One researcher said that gaining the knowledge about any method or approach that could improve his own work is paramount and something that he has had difficulty with in the past. *"I should've known about ***** a long time ago because I'd be doing it now if I – and*

a long time is about a year. That's a long time ago." He says that society meetings do offer some help on latest tools but for someone like himself who gets buried in his work and misses information about new tools, he could use some help. *"There's a tremendous amount of resources that a librarian could help ... manage or educate people about."*

D. OA journal quality determination help

Several researchers expressed interest in the principles in open access (OA) publishing, especially the fact that OA articles are freely available to the research community. However one researcher expressed dismay about how to find appropriate OA journal publication venues. *"The fact that there are just so many of these open access – 'who knows' journals. It's your favorite journal's name plus another word ... I don't know if that's a big problem, the system's just really flawed, you want to support more open access."* This is a common difficulty for those looking to publish or referee for OA journals, as new titles of unknown quality are regularly established. A reliable guide or service on how to identify quality OA journals for potential scholarly work could be a useful contribution.

E. Data sharing

Most of the faculty interviewed do not currently share their data. They have either had no reason to do so, actively do not want to do so, or it just never occurred to them to do so. One researcher said, *"Why not? I just don't know how it's applicable to my research. And [it] may be something I need to learn and need to know more since you have this question. It seems like we're supposed to know how."* Said another researcher: *"Why not is really because no one's told me I had to. Which I'm sure is going to be a common answer. I don't have anything against it, I just never been asked to so I have not."* Since the primary funder for agriculture, the USDA, now requires data management plans of all grant applicants and data sharing of all grant recipients, this is something that all faculty writing proposals for grants from federal funders with those requirements will need to do. The Library already offers assistance to those writing data management plans (DMPs) and to those trying to identify repositories for archival sharing. Additional support is possible, such as in the description of data gathered and in the preparation of data sets for preservation.

F. Data analysis software

Faculty, when asked about the software they used to analyze research data, said they used the software SAS if they used anything. Some were not aware of other options for data analysis and those that were didn't have the time to investigate them. Keeping faculty up to date on the latest data analysis software options like R and Python and finding ways to quickly and thoroughly train those interested in using new software could be a valuable research support service. Data visualization options could be another useful area in which to provide them with support.

Finding 5: Faculty roles in public perceptions of agriculture

According to agriculture researchers, public perception of their work is often flawed and frustrating. Consumers get a lot of information about agriculture from media sources, some of which is accurate but much of which is not. This particularly pertains to genetic engineering of animal and food products. One of the faculty concerns is for funding: *“In my field a lot of it’s consumer perception, genetic engineering, a lot of our future’s in genetic engineering and there’s a lot of pushback from consumers and if you get that pushback I worry that the funding for some of this stuff is withheld because of the potential.”*

Another area of concern is the public perception of conventional agriculture in this country, both in terms of humane food animal conditions and also of genetically modified organisms. Researchers expressed frustration in the dichotomy between public perceptions and the reality of providing food to large populations. *“I think one of the major challenges is this whole - how do we convince people that there are things that go on in raising animals and animal production that get vastly blown out of proportion and the health risks aren’t health risks?”* Hormone and antibiotic use in animals and use of genetically modified plants were high on the list of issues that were expressed as essentially non-issues. Said one researcher: *“There’s got to be a balance between if this is how you want your animals raised and how you want the meat you purchase to be raised, that’s fine, I have no problem with that. But at the same time we need economical ways to produce protein for lots of people. And we have managed to do that with conventional agriculture in what I think is a humane way in most cases - not all cases, there’s always the bad eggs. But it’s trying to make that argument in a way that is heard by the general public and not the ‘Monsanto pays your salary’ because Monsanto sure doesn’t pay my salary or even fund my research.”* Another researcher stated about genetic engineering of plants, *“We’re going to die if we do not allow [it], if you look at developing countries. GMO products are very important in trade to feed the world.”*

Countering public opinion with fact based information was suggested as a response. *“Those kinds of PR issues I think are a huge challenge for our field. I don’t know how to overcome those other than just talking to people as a ‘this is me and this is what I do and this is how I think based on my experiences.’ I know there are people that are running great blogs and do a lot of PR outreach in their positions and it’s fantastic.”* Clearly public perceptions and acceptance are a concern for some agriculture researchers. It is not currently clear what role researchers should play in mediating the public perception of agriculture.

Finding 6: Ideas for the future

Researchers had concerns about future environmental issues that would impact agriculture and others that are created by agriculture which could be solved in novel ways. The impact of climate change was one focus, with the potential introduction of new invasive species that could damage agricultural crops because of warmer winters. *“I think that the environment is*

probably the biggest one because and we will get more pests that will survive our winters up here that probably wouldn't have survived a few decades ago. And this year we didn't have a winter."

According to another researcher, agriculture's worst impact upon the environment is through agricultural pollution. *"We are facing the environmental issues created by agriculture. Agriculture in fact is the biggest polluter on earth. Many people may not realize that fertilizer use, pesticide use, that's created the biggest pollution, more than any other industry combined in fact."* A researcher proposed a potential remedy to this threat by reducing or eliminating use of herbicides and/or pesticides through use of agricultural robots in fields programed to kill weeds or pests. *"Imagine a robot runs on wheels, has solar panels, and is trained to identify weeds and kill it but doesn't kill the crop, just the weeds. What consequence would that do to herbicides and pesticides? How would that change the whole distribution of chemicals in agriculture if you had something mechanical that could kill instead of something chemical to kill it?"* Novel ideas may be the currency of the future as we deal with agriculture changes in the coming decades.

CONCLUSIONS

The variability in research methodologies and the wide scope of subject matter make it hard to draw specific conclusions about agriculture research at UConn. Each researcher has as many differences from the others interviewed as there are similarities, in every aspect discussed. However there are some distinct patterns that we found, illustrated in the findings section. If we use this group of nine interviews as indicators of agricultural research at the University of Connecticut as a whole, the following general conclusions can be drawn:

- Funding is crucial to accomplishing anything.
- External funding is hard to find, especially from federal funders who pay indirect costs.
- Internal funding is getting harder to find but is crucial for supporting research, both to pave the way for getting external funds and to permit external proposals to be as competitive as possible.
- Not all funding is created equal; sources which pay indirect costs may be favored over those who do not.
- Assistance with research is crucial; no faculty can do all their research themselves.
- Graduate students are the most common form of assistance and cost the least.
- Graduate students take the most time to train and are of course temporary, making them the most work-intensive assistance for research.
- Graduate students may become future competitors for scarce funding resources.
- New equipment which reflects technological advance is very expensive and thus centralized campus and/or college access makes the most sense most of the time.

- Not all equipment is available in a centralized campus location so a subsidized equipment purchasing program within CAHNR would be useful.
- The primary peer reviewed journal article remains the lingua franca for agricultural research, for both information finding and information dissemination.
- Google Scholar and PubMed are the most important sources for literature searching; Cab Direct, Scopus and Google are the next most important; Agricola runs sixth in importance.
- Networking is a significant component of researcher information seeking and the primary means is through professional societies, but specific society memberships change as research interests change.
- Interdisciplinary researchers must frequent multiple societies to keep in touch with different aspects of their research but they may not be able to attend multiple conferences in a year.
- For many researchers finding the right audience is the most important aspect of selecting a journal in which to publish.
- Journal impact factors and other numerical indicators are important but secondary.
- Technological advances change how research is conducted and are anticipated to do so for the foreseeable future.
- Keeping up with technological advances and the applications and tools they create takes intentional effort. Learning about technology and tools is part of how researchers must spend their time. This is an area where researchers need support.
- Writing manuscripts and grant proposals is time consuming and difficult for non-native English speakers. This is an area where researchers need support.
- Updating applicable campus research standards to the animal models used in agriculture would streamline agriculture research protocols.
- Providing guidance on Open access journal selection and quality may increase interest in publishing in and reviewing for open access publications. This is an area where researchers need support.
- Most faculty are not currently sharing their research data. Federal funding agencies now require data sharing so this is an area where researchers need support.
- Most faculty use the software they already know for data analysis. Because of time constraints they are not investigating or using new and potentially powerful data analysis tools. This is an area where researchers need support.
- Faculty have concerns about public perception of modern agriculture but are not sure how to help alter those perceptions.

This study has been informative to the Library on many levels, giving us valuable insight into the process of research for the faculty of two departments of CAHNR. The ethnographic approach of asking questions and listening to the answers, while not new to us, has provided access to a depth of information about our researchers that we never before had and which has been very gratifying.

Although this study was done by a team of librarians and the report was paid for by the Library, it draws conclusions that are potentially useful on a broader scale because research support comes from the entire university system. We welcome a dialog on that broader scale and hope that we can work together with other campus units to support and enhance the agricultural research done at the University of Connecticut.

We wish to thank the nine researchers who gave us their time, thoughts and ideas and we hope we have done justice to the trust which they placed in us. We also wish to thank Cameron Faustman, the Associate Dean of Academic Programs for CAHNR as well Steve Zinn and Richard McAvoy, the department chairs of Animal Science and Plant Science & Landscape Architecture, for encouraging faculty participation in this study. We thank Martha Bedard, Vice Provost for the University of Connecticut Library, for funding our participation in this study. And we thank Danielle Cooper and the staff at Ithaka S+R for coordinating the study and working with us throughout the process.

REFERENCE

College of Agriculture, Health and Natural Resources. Academic Plan. University of Connecticut. n.d. http://www.extension.uconn.edu/root/archives_11_3851162357.pdf

Appendix A: Recruitment Email Template

Subject: Invitation to Participate in Study on Research Support Services for the Field of Agriculture

Dear [Name]:

You are invited to participate in a research study to examine the research practices of academics working in agriculture. You are being asked to participate because you currently conduct research in an aspect of the field of agriculture.

If you agree to take part in this study you will be asked to participate in an approximately 60 minute digitally-recorded interview (audio only) in your office at a mutually agreeable time during the workday. We will ask a set of questions about your research practices and support needs as an agriculture scholar. We also may take photographs to document your work space, however, you will not appear in the photographs. The study requires one interview with no additional contact.

This project is part of a larger suite of similar studies being concurrently conducted at agriculture libraries in US higher education institutions in conjunction with Ithaka S+R, a not-for-profit research and consulting service that helps academic, cultural, and publishing communities. The information gathered in this study will also be used to write a report from the aggregated results that will be written and publically disseminated. This report will provide insight into the research support services needs of the agriculture community more broadly.

To learn more about the study, please don't hesitate to contact Carolyn Mills or Sharon Giovenale here: Carolyn.mills@uconn.edu or Sharon.giovenale@uconn.edu

Sincerely,

[name and title]

Appendix B: Semi-structured Interview Questions

Research focus

1. Describe your current research focus and how this focus is situated within the broader agriculture discipline and the academy more broadly. [Probe for whether/not they see themselves as located firmly within agriculture as a discipline or located across/between disciplines]

Research methods

2. What research methods do you currently use to conduct your research?
3. What kinds of data does your research typically elicit?
4. How do you locate the primary and/or secondary source materials you use in your research?
5. Think back to a past or ongoing research project where you faced challenges in the process of conducting the research.
 - a. Describe these challenges.
 - b. What could have been done to mitigate these challenges?
6. How do you keep up with trends in your field more broadly?

Dissemination Practices

7. Where do you typically publish your research in terms of the kinds of publications and disciplines? How do your publishing practices relate to those typical to your discipline?
8. Have you ever deposited your data or final research products in a repository?
 - a. If so, which repositories and what has been your motivations for depositing? (i.e. required, for sharing, investment in open access principles)
 - b. If no, why not?

Future and State of the Field

9. What future challenges and opportunities do you see for the broader field of agriculture?
10. If I gave you a magic wand that could help you with your research and publication process – what would you ask it to do?

Follow-up

11. Is there anything else about your experiences as a scholar of agriculture and/or the agriculture discipline that you think it is important for me to know that was not covered in the previous questions?